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Analysis of the renewable energy promotion in Lithuania in compliance with the European Union strategy and policy

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ABSTRACT

The article outlines the analysis of the renewable energy sources (RES) promotion in Lithuania in compliance with the European Union (EU) strategy and policy. Energy consumption from RES in 2005, progress in 2011 and targets for 2020 years for Lithuania and the EU-27 countries are compared. Lithuanian targets of RES shares are the following: total final energy consumption – 23%, 10% – in transport, 20% – in electricity consumption, and 60% – in district heating. The overview of available RES support instruments for electricity, heat and cooling, and transport in Lithuania and EU countries is carried out. Lithuanian RES policy, strategic directions, objectives and tasks are discussed. The recent tendencies of energy use in Lithuania are revealed. The distribution of gross inland and renewable fuel and energy consumption for the period 2005–2011 is shown. Expected gross final energy consumption for heating and cooling, electricity and transport sectors, and RES contribution to each sector of the final energy consumption up to 2020 are foreseen. A feed-in tariff system in Lithuania, the measures for power and heat generation, and the support schemes to promote the use of energy from RES in transport are described. The measures taken to ensure availability of necessary funding to achieve the Lithuanian targets for the share of RES are shown.

Contents

Abbreviations: CHP, combined heat and power; EAFRD, European Agriculture Fund for Rural Development; EC, European Commission; EU, European Union; GHG, greenhouse gases; IC, installed capacity; ktoe, kilotons of oil equivalent; LEI, Lithuanian Energy Institute; LEIF, Lithuanian Environmental Investment Fund; LTL, Lithuanian Litas (1 LTL=0.2896 €); NCC, National Control Commission; PV, photo voltaic; RES, renewable energy sources; RES_E, renewable electricity; RME, rapeseed methyl ester; RPS, Renewable Portfolio Standards; UK, United Kingdom; USA, United States of America

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1. Introduction

1.1. Promotion of use the renewable energy in Europe

The Directive 2009/28/EC on promotion of the use of energy from renewable sources (RES) sets the overall target to reach 20% renewable energy in gross final energy consumption in 2020, [1]. This target is bound with individual Member State targets. Lithuanian target is to reach 23% of RES in gross final energy consumption till 2020.

Energy consumption from RES in 2005, progress in 2011 and targets for 2020 for Lithuania and the EU-27 countries are shown in Fig. 1 [2].

Reaching these targets will require a huge mobilization of investments in renewable energies. In order to improve financing and coordination, the Directive requires: a better use of structural funds and framework programmes; a better and increased use of funds from the European Investment Bank and other public finance institutions; a better access to risk capital; a better coordination of Community and national funding and other forms of support; a better coordination in support of renewable energy initiatives whose success depends on action by actors in several Member States and other ones.

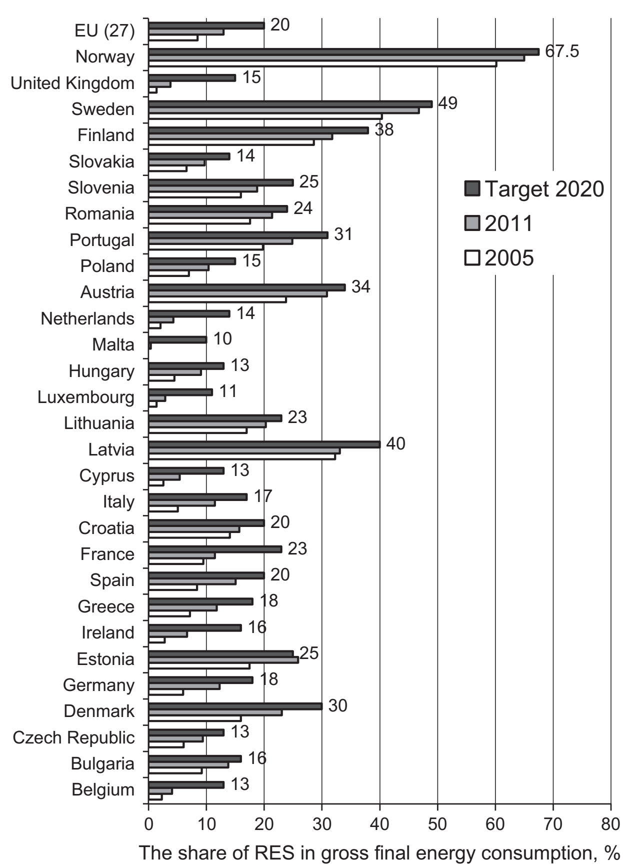


Fig. 1. Energy consumption from RES in 2005, progress in 2011 and targets for 2020 for Lithuania and the EU-27 countries.

The most important obstacles for faster growth of RES usage in Lithuania were high investment cost, long pay-back periods for projects and a lack of financial resources necessary to implement governmental policies [3]. The analysis of the renewable energy directive by a techno-economic optimization model was made by experts in [4]. This model was developed especially for Norway and set a possible ways to reach its RES target (67.5%) for 2020. Also, it is very valuable for other EU countries by setting their individual targets.

The status of current RES deployment, policies and barriers in the EU-27 member states and compares it to the required to meet the 2020 targets were analyzed in [5]. It was emphasized that European RES deployment and policy have strongly progressed in recent years. Despite this, Europe will need additional policy effort to reach the 2020 target. Critical success factors included implementation effective and efficient policies that should attract sufficient investment and reduce administrative and grid related barriers.

The analysis of the renewable energy use in European Union (EU) was investigated by many researchers [6–10]. Proposed measures on renewable heat and electricity, biofuels and energy efficiency have achieved important results but lack to bring sustainability, security of supply and competitiveness. No one element of the policy provides all the answers because they must be taken together as a whole. The status and perspectives of renewable energy policy and deployment in the EU and what is needed to reach the 2020 targets must be established. Also other problems of renewable energy as well as the renewables portfolio, individual preferences and social values towards RES technologies and implementing a biofuel economy in the EU and future perspectives for the next generation biofuels must be studied carefully [11–13]. Different scenarios of high penetration renewable energy showed that the use of renewable energy was attractive in many EU Member States [14–17].

Strategic analysis of diffusion of RES in Nordic countries [18] were related to security of energy supply, growing energy demands, limitations of fossil fuels, and threats of disruptive climate changes and were highlighted that successful diffusion of RES requires consideration to many factors including social, economic, and technical ones. The challenges, prospects, environmental impacts and policies for renewable energy and sustainable development in Greece, Germany and other countries were described in [19–21]. The challenge for renewable policy is to find the right balance between installing large scale renewable energy capacity today, and waiting until research lowers their cost tomorrow. It is evident that using renewable energy today is generally more expensive comparing to using hydrocarbons, but when the costs climate change are factored in the gap is narrowing. How the renewable electricity policies promote renewable electricity generation and the conditions and costs for renewable electricity grid connection were overviewed

in [22–25]. There are very more problems to use solar photovoltaic in the Nordic countries as well as Sweden, Baltic countries, Norway, etc. More efforts must be done for the improving technology possibilities for the reduction cost of the equipment.

The transition from traditional to sustainable energy development in the region of Western Balkans, a quantitative analysis of differences in installed wind power capacity across Swedish municipalities, the economic wind power potential in other countries was disclosed in [26–28]. The benefits of the renewable production of electricity and the incentives to promote solar thermal energy in Czech Republic, Romania, Spain and Greece were reviewed in [29–33]; current support systems and the costs of integrating RES into electric system were shown and the support measures at all administrative levels: central, regional and local have been developed. Renewable electricity supply is a crucial factor in the realization of a low-carbon energy economy. Increased the use of renewable energy in order to reduce carbon-dioxide emissions is the main target of market actors of all countries.

The studies of renewable electricity generation by pumped storage power plants (PSPs) operating all over the EU, buffering intermittent renewable power with hydroelectric generation and methodology for evaluating the economic potential of renewable energy from an energy mix perspective were analyzed in [34–36].

1.2. Overview of the RES support instruments

Every EU Member State has elaborated its own pathway for achieving the target for promotion renewable energy in own country. The renewable heat policy and overview of support options were studied in [37]. Were highlighted that effective renewable heat policy must consider wider regulation and planning issues and the relative maturity of technologies. Exploring the concept of feed-in tariff for energy savings was made by specialists in [38] and was shown that rewarding energy savings are rather than energy efficiency, besides, financial incentives are important for overcoming certain market barriers to improved energy efficiency and for the adoption of energy efficient technologies. The feed-in tariffs suitable for promoting solar PV were studied in [39], and were defined that feed-in tariffs could greatly increase investor security and ease grid connection. The assessment of the cost-efficiency and the affectivity of renewable energy support schemes (Certificate markets versus feed-in tariffs) and Economic feasibility of large community feed-in tariff eligible to wind energy production were studied in [40,41]. The determinants of green electricity tariffs uptake in UK and concentrating solar power (CSP) plant investment, operation decisions under different price and support mechanisms were analyzed in [42,43]. Policies to support the growth of RES of heat were thoroughly overviewed on "Energy Policy" editorial article [44].

The main support instruments used in the EU are feed-in tariffs, feed-in premiums, and quota obligations. A feed-in tariff is a fixed and guaranteed price paid to the eligible producers of electricity from RES. In a feed-in premium system, a guaranteed premium paid in addition to the income producers receive for the electricity from RES that is being sold on the electricity market. Quota obligations create a market for the renewable property of electricity. The government creates a demand through imposing an obligation on consumers or suppliers to source a certain percentage of their electricity from RES. Table 1 provides an overview of the renewable electricity, heating and cooling, and transport support instruments that are available in the areas of the EU Member States [45–47].

Feed-in tariff systems (Table 1, A) currently are the main instruments of support in the EU. They are used in the following

Table 1
The overview of main RES support instruments in the EU-27.

Main support instruments of renewable energy sources (RES) in the EU-27											
	RES electricity						RES heating and cooling			RES biofuels	
	A	B	C	D	E	F	D	E	F	C	E [a]
Austria	+						+	+		+	+
Belgium	+		+	+	+		+	+			+
Bulgaria	+					+	+		+	+	
Cyprus	+			+			+			+	+
Czech Republic	+	+		+			+			+	+
Denmark	+					+	+		+	+	+
Germany		+						+		+	+
Estonia	+	+				+	+		+		+
Spain	+	+			+					+	+
Finland				+	+		+			+	
France	+						+	+	+	+	+
Greece	+			+	+		+	+			+
Hungary	+			+			+				+
Ireland	+						+			+	+
Italy	+		+					+			+
Lithuania	+			+			+	+		+	+
Luxembourg	+			+			+			+	+
Latvia	+			+	+		+			+	+
Malta	+			+		+	+				+
Netherlands		+			+	+	+	+		+	
Poland			+		+	+	+			+	+
Portugal	+						+		+	+	+
Romania			+							+	+
Sweden			+		+		+	+			+
Slovenia	+	+				+	+			+	+
Slovakia	+				+		+			+	+
United Kingdom	+		+		+		+	+		+	+

[a] Support instruments: A – feed-in tariffs; B – feed-in premiums; C – quota obligation; D – investment grants; E – tax exemptions; F – fiscal incentives.

Member States: France, Germany, Spain, Greece, Ireland, Luxembourg, Austria, Hungary, Portugal, Bulgaria, Cyprus, Malta, Lithuania, Latvia, and Slovakia. Most countries use a differentiation according to technology, which facilitates the development of a range of technologies due to the different level of tariffs they receive. However, a few countries, including Cyprus and Estonia, do not differentiate according to technologies, and apply a common feed-in tariff for all technologies.

Feed-in premium systems (Table 1, B) have gained ground over the last years and are used as main support instruments in Denmark and the Netherlands. In Spain, Czech Republic, Estonia and Slovenia premiums exist in parallel to the tariff system. These Member States have introduced the possibility to choose between feed-in tariffs and premiums for a selection of technologies. The flexibility and coverage of the systems differ from country to country.

Premium systems provide a secure additional return for producers, while exposing them to the electricity price risk. Compared to feed-in tariffs, premiums provide less certainty for investors and hence, imply higher risk premiums and total costs of capital.

Renewable or quota obligations (Table 1, C) have been introduced in Belgium, Italy, Sweden, UK, Poland and Romania. In countries with quota obligations, governments impose minimum shares of renewable electricity on suppliers (or consumers and producers) that increase over time. If obligations are not met, financial penalties are to be paid. Penalties are recycled back to suppliers in proportion to how much renewable electricity they have supplied. Obligations are combined with renewable obligation certificates that can be traded.

Related advantage of quota obligations compared to feed-in tariff and premium systems, is the fact that support is automatically phased out once the technology manages to compete. Tradable certificates represent the value of the renewable electricity at a

certain time. When the costs of renewable technologies come down through learning, this is represented by the adjustment of the price of certificates.

On a national level, investments grants (Table 1, D) for RES-E are available in several Member States and are often constructed to stimulate the take-up of less mature technologies, such as photovoltaic. In Finland, investment grants and subsidies are the only support available on a national level.

Tax incentives or exemptions (Table 1, E) are often complementary to other types of renewable energy incentive programmes. They are powerful and highly flexible policy tools that can be targeted to encourage specific renewable energy technologies and to impact selected renewable energy market participants, especially when used in combination with other policy instruments. A wide range of tax incentives are present in the EU. Some countries, including Spain, Netherlands, Finland and Greece, provide tax incentives related to investments (including income tax deductions or credits for some fraction of the capital investment made in renewable energy projects, or accelerated depreciation). Other Member States, including Latvia, Poland, Slovakia, Sweden and the UK, have devised production tax incentives that provide income tax deduction or credits at a set rate per unit of produced renewable electricity, thereby reducing operational costs. Investment and production tax exemptions are most prominently present in the EU.

A related category are fiscal incentives (Table 1, F), including soft – or low-interest loans that are loans with a rate below the market rate of interest. Soft loans may also provide other concessions to borrowers, including longer repayment periods or interest holidays. On a national level, soft-loans are available in Germany, Netherlands, Bulgaria, Estonia, Malta and Poland.

Financial support instruments for RES heating and cooling (Table 1) can be grouped into three categories: investment grants (D), tax exemptions (E), financial incentives and premiums (F). The deployment of (combinations) of these instruments varies largely from country to country and from technology to technology. The main support comes in the form of investment grants and tax exemptions. These are available in quite some Member States for most RES heating and cooling technologies. Financial incentives such as soft loans are less commonly available. RES based district heating receives relatively little attention from the Member States. Austria, Finland, Hungary and Lithuania are exceptions. Use obligations are applied in Spain and Germany, but they are rather a regulatory than a financial instrument.

The Biofuels Directive of 2003 evoked the growth of biofuels production and application in Europe, and now the Renewable Energy Directive will shape the European market for biofuels until 2020. Under current EU policies, the Member States are aiming to produce a 10% of their road fuels from renewable sources such as biofuels by 2020. Also, the directive has led most Member States to adopt intermediate targets. The instruments to support biofuels consumption in the Member States are often a combination of a quota obligation (C) with tax exemptions (E), (Table 1). In some countries only one of these two instruments is used. The levels of support for biofuel obligations are very difficult to assess since the prices implied by these obligations are typically not public.

1.3. National review on renewable energy

The use of renewable energy sources and rational use of energy are fundamental goal for a responsible energy policy of the future in Lithuania. The stimulation of energy producers and consumers for the efficient use of renewable sources are the major target of Lithuanian government [48–50]. According to the Law on Energy of Lithuanian Republic, a renewable energy is defined as well as a source that use in the process of transformation energy of wind, solar radiation, hydro energy and energy from biomass, landfill gas, biogas from waste water treatment and biogas from decayed residues of plants and/or from animals. Most efforts in Lithuania were aimed to developing biomass (wood, chips, wood waste, straw, biogas) and small hydro projects and their subsequent implementation [51]. No serious obstacles can be seen for the extension of wood fuel usage. Prices of fuel market depend on local conditions, as well as on the number of fuel consumers, capacity of installed wood burning boilers, etc. Local industry is created for the production of biomass combustion equipment. Renewable energy technologies are capable of preserving resources, of ensuring security and diversity of energy supply, and providing energy services, virtually without an environmental impact. The comparative assessment of policies targeting energy use efficiency in Lithuania was done in article [52]. Promoting interactions between local climate change mitigation, sustainable energy development and rural development policies in Lithuania were analyzed in [53]. The EU Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport is basic document determining policy of Lithuania in the area of biofuels. The impact of international GHG trading regimes on penetration of new energy technologies and feasibility to implement EU Energy and Climate Package targets was studied in [54].

Despite the government policy efforts, accepted legislated base and the programs on the enhancement of renewable energy use, due to expensiveness of alternative energy technologies and various constraints, total contribution to the development of the renewable energy technologies as well as wind, solar, bio-fuel, biogas, etc. is very significant in this time. More effective introduction can be obtained due to the co-operation of Lithuania with other countries. Also the government must create a special subsidy policy to promote the usage of renewable energy sources. The sustainable Lithuanian economy development and change of fuel and energy consumption were analyzed in [55,56]. Special emphasis should be given to wind energy so as to increase electricity production. The cases of subsidy for each renewable energy sources must be developed individually The Lithuanian RES sector strategy (vision, current situation, strategic initiatives) was disclosed in National Energy Independence Strategy of 2012 [57] and other governmental resolutions [58,59]. A subsidy given to some renewable sources also makes these sources more affordable for local and foreigner investors.

2. Lithuanian energy policy on promoting RES

The National Strategy for the Development of RES, recently approved by Resolution no 789 of the Government of the Republic of Lithuania, indicates that Lithuanian energy policy set an increasingly great emphasis on the development of RES and it is considered to be one of the most important priorities of the National Energy Policy [58].

Lithuanian vision regarding the development of RES is to promote the use of RES as a matter of exclusive priority; to achieve that RES would become the most important part of the country's primary energy sources as soon as 2020. The sector of RES would fully satisfy the country's demand for heating, and electricity would be produced at power plants that are neutral in terms of carbon dioxide (electricity is produced from renewable energy sources and at the new nuclear power plant); there would appear vehicles using pure biofuel and electrical power. This would result in lower adverse impact of energy and the transport sector on the environment. Creation of new jobs, encouraged development of technologies and promotion of scientific research on the basis of the development of RES would allow creating, patenting and

manufacturing installations producing energy from RES in Lithuania. The sector of RES will become the driving force for the country's economy [59].

Lithuanian target is to increase the share of RES to at least 23% of the country's final gross energy consumption by 2020 (Fig. 1.).

The development directions of RES have been established for all three sectors – electricity, heating, and transport.

Strategic goal of the national RES development is to satisfy the demand for energy with local resources to the maximum extent possible, to abandon imported polluting fossil fuel, thus improving the reliability of energy supply and energy independence and to contribute to international efforts to reduce emissions of greenhouse gas by increasing the share of RES in the country's energy balance, in the electricity and heating, and transport sectors.

Objective of the RES development is to ensure that the share of RES in the country's total final consumption of energy would reach at least 23% till 2020 [59], i.e. to seek the following:

- To increase the share of RES consumed in all kinds of transport to 10% of the final consumption of energy in the transport sector till 2020;
- To increase the share of electricity produced from RES to 21% in the country's total electricity consumption till 2020;
- To increase the share of RES in heating and cooling to 36% in the gross final consumption of this sector till 2020, and to increase the share of district heating produced from RES to 50% till 2020.

The tasks of the development of RES:

- To coordinate the actions of market participants of separate sectors and to involve municipalities in the promotion of the use of RES.
- To improve and implement support schemes which would create favorable conditions for the use of RES – to prioritize projects which would bring the maximum effect at minimum cost and would enable every potential investor to participate in the activities related to RES in accordance with transparent, simple, no discriminating and public selection procedures.
- To ensure that all administrative procedures intended for projects for RES would be proportionate, simple and transparent.
- By effectively developing electricity, thermal energy and gas infrastructure, to create favorable and transparent conditions for the implementation of projects for RES and to coordinate the development of RES with the principles of distributed (decentralized) generation.
- To increase the use of all types of biomass for thermal energy and electricity production.
- To increase the use of RES and electricity in the transport sector – to ensure that biofuels and other bioliquids meet the sustainability criteria.
- To carry out scientific research, pilot projects, applied work, and informational and educational activities on issues of the use of RES.

3. Analysis of RES usage in Lithuania and expectations

For the Lithuanian needs were used the imported and indigenous and renewable energy resources. Before 2010 the Lithuanian gross inland consumption consisted of the nuclear energy, hydropower, wind, geothermal, energy from chemical processes, oil products, natural gases, wood, coal and other fuel. About third of gross inland fuel and energy consumption belonged to nuclear energy.

Lithuania has limited quantity of indigenous energy sources and was depended from import of energy resources (natural gas, petroleum, hard coal). In 2009, Lithuanian energy dependence from such resources comprised approximately 50.3%. The prices of imported organic fuel continually raised and constantly increased the consumption of indigenous and renewable energy sources. The distribution of gross inland fuel and energy consumption in Lithuania for the period 2005–2011 is shown in Fig. 2.

From 2005 to 2008 the consumption of oil products in Lithuania increased from 110 to 124 PJ (about 13%). In 2009–2011 the consumption of oil products decreased to 102–104 PJ. Such indices depended basically from the import of oil products.

The consumption of natural gasses from 2005 to 2008 increased from 104 to 109 PJ, i.e. on approximately 5%. In 2011 the consumption of natural gasses reached 114 PJ.

In 2009 the most part, 29.7% of gross inland consumption depended on nuclear energy, the next was crude oil and petroleum products – 28.7% and natural gas – 25.1%. Renewable and indigenous energy sources consisted 14.7% of gross inland fuel and energy consumption.

At the end of 2009, according the requirements of EU, the Lithuanian Ignalina NPP was closed. The structure of gross inland fuel and energy consumption in Lithuania changed radically. According to the data of Statistics Lithuania, in 2011, compared to 2009, gross inland fuel and energy consumption reduced on 14.3% (from 356 to 305 PJ) [60–62].

In 2011 the distribution of Gross inland fuel and energy consumption in Lithuania were: electricity – 7.9%, crude oil and petroleum products – 33.6%, natural gas – 37.3%, coal and coke – 2.9%, indigenous and renewable energy – 18.3%, Fig. 3 [62].

Both domestic and imported fuel and energy resources were used to satisfy domestic consumer needs. Lithuania imports the main fuel and energy resources: natural gas, petroleum, and hard coal. In 2010, Lithuania's energy dependence on the imports of fossil fuel considerably increased – from 50.3% in 2009 to 81.8% in 2011 and substantially exceeded the EU average 53.8%.

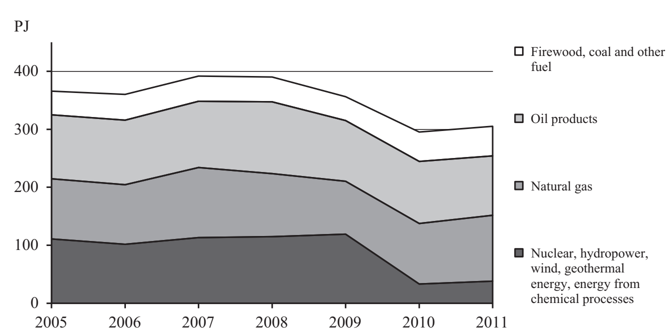


Fig. 2. Gross inland fuel and energy consumption in Lithuania for the period 2005–2011.

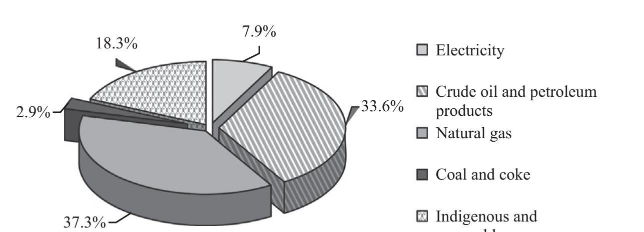


Fig. 3. Distribution of gross inland fuel and energy consumption in Lithuania in 2011.

As the prices of imported organic fuel In Lithuania progressively grow, the result was gradually increased usage of indigenous and renewable energy sources. About 42% of indigenous and renewable energy sources in Lithuania were transformed in CHP and heat plants, 45.1% – used in households, 5.7% – in industry and 7.4% – in other sectors.

The percentage distribution of renewable energy consumption in Lithuania in 2011 is shown in Fig. 4 [62]. The biggest part of such resources was biomass – 86.5%, liquid biofuel – 4.4%, hydropower – 3.9%, wind energy – 3.9%, biogas – 1.0% and geothermal energy – 0.3%.

Today the greatest RES potential in Lithuania is shown by biomass, especially firewood and wood waste.

According the statistics of Lithuania, in 2010 the energy from renewable energy sources produced 119 power stations: 3 biomass, 5 biogas power, 86 hydropower and 25 wind power stations. Wind farms are one of the most environment-friendly and rapidly developing renewable energy technologies in Lithuania, wherein started to produce electricity from 2004. In 2009 the energy produced from wind power in Lithuania comprised 1% (0.57 PJ) of all produced electricity, in 2010 – about 3.9% (0.81 PJ). From 2010 to 2011 electricity production on wind farms increased 2.1 times (to 1.71 PJ) and accounted for 9.9% of the total electricity production in the country.

The share of RES in the total energy consumption in Lithuania for the period 2005–2011 increased from 10.0 to 14.5% (Table 2) [63,64]. The share of electricity from RES in gross electricity consumption for the period 2005–2009 increased from 3.9 to 5.5% and for the period 2009–2011 – from 5.5 to 9.6%.

The share of biofuel in road transport fuel consumption increased from 0.5% in 2005 to 4.3% in 2009 and in 2011 slightly decreased to 3.7%. In 2011 were consumed 14.6 thousand tons of bioethanol and 40.0 thousand tons of biodiesel in Lithuania.

In order to diminish the dependence on imported fuel and reduce the impact of fossil fuel on the environment, a wide use of RES is of great importance. A wider use of RES in electricity and heat production and transport enables to reduce the consumption of imported fossil fuel, especially natural gas and petroleum products.

Biofuel production and consumption in Lithuania are regulated by international obligations related to reduction in greenhouse gas emissions and increase in biofuel use in transport. The main types of biofuel consumed in Lithuania are biodiesel and bioethanol, which were started to be produced from 2004.

Percentage increasing the share of RES in the total energy, in the total electricity consumption and in fuel consumption of transport in Lithuania for the period 2005–2011 is shown in Fig. 5.

Comparison of the share of RES in gross electricity consumption in 2007, 2009, and 2011 year for Lithuania and the EU-27 countries is shown in Fig. 6 [65].

The greatest share of RES in gross electricity consumption, about 100% is in Norway, about 60% – in Austria and Sweden, about 40% – in Denmark, Latvia and Portugal, about 20% – in Germany, Ireland, Italy, Slovakia and EU-27 countries. The Lithuanian share of RES in gross electricity consumption is about 10% in 2011 and was about twice less than EU-27 average.

The share of RES in fuel consumption of transport in 2007, 2009, and 2011 for Lithuania and the EU-27 countries are shown in Fig. 7 [66].

The biggest share of RES in fuel consumption of transport, about 8% have Austria and Sweden, about 6% – Germany, Spain, France and Poland, about 4% – Italy, Latvia, Lithuania, Hungary, Netherlands, Norway and EU-27 countries.

Gross final energy consumption of all types of energy (from both renewable and conventional sources), overall and for each sector, in the period up to 2020 were set out on National Renewable Energy Action Plan [59]. Performed estimates take into account the expected effects of energy efficiency and saving measures to be introduced during the period. Under the heading "additional energy efficiency scenario", a scenario is presented taking into account all measures to be adopted from 2009. The elaboration of the other parts of the National Renewable Energy Action Plan is based on this additional energy efficiency scenario.

For the purposes of monitoring the implementation of the development of renewable energy sources in Lithuania, the **results (assessment criteria)** were established, which are directly related to the goals and tasks of the development and allow regular assessment of the achieved progress. The average share of RES for 2013–2014 should account not less than 17.4% of the gross final energy consumption, for 2015–2016 – 18.6%, for 2017–2018 – 20.2% and in 2020 – not less than 23.0%.

The expected gross final energy consumption in Lithuania for heating and cooling, electricity and transport sectors, and

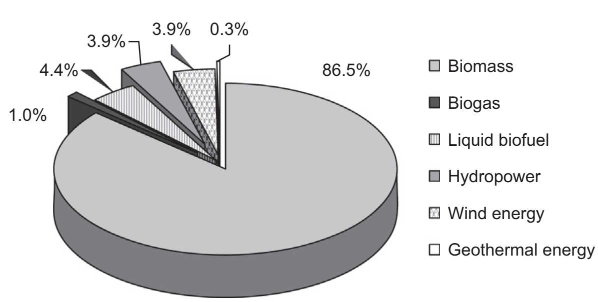


Fig. 4. Distribution of RES consumption in Lithuania in 2011.

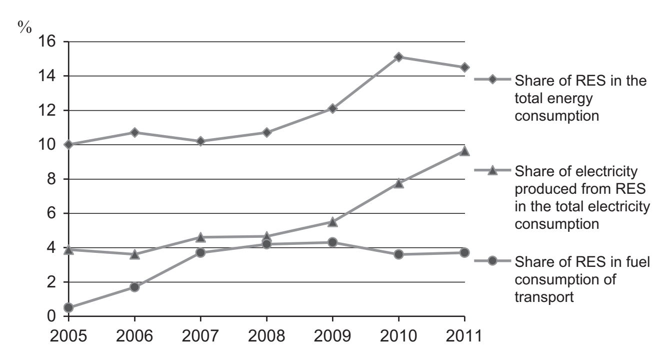


Fig. 5. Percentage increasing the share of RES in Lithuania for the period 2005–2011.

Table 2
The share of RES in the total energy consumption in Lithuania (%).

Renewable energy resources	2005	2006	2007	2008	2009	2010	2011
Share of RES in the total energy consumption	10.0	10.7	10.2	10.7	12.1	15.1	14.5
Share of electricity from RES in gross electricity consumption	3.9	3.6	4.6	4.7	5.5	7.8	9.6
Share of biofuel in road transport fuel consumption	0.5	1.7	3.7	4.2	4.3	3.6	3.7

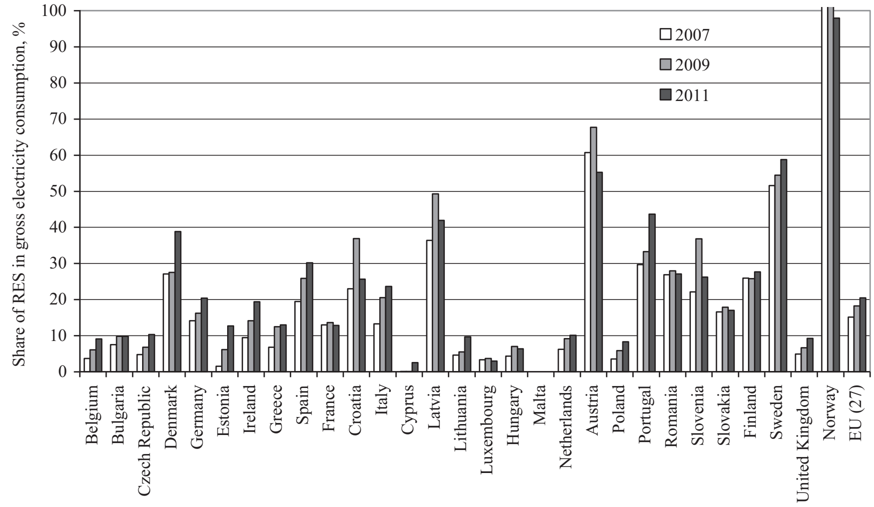


Fig. 6. The share of RES in gross electricity consumption in 2007, 2009 and 2011 for Lithuania and the EU-27 countries.

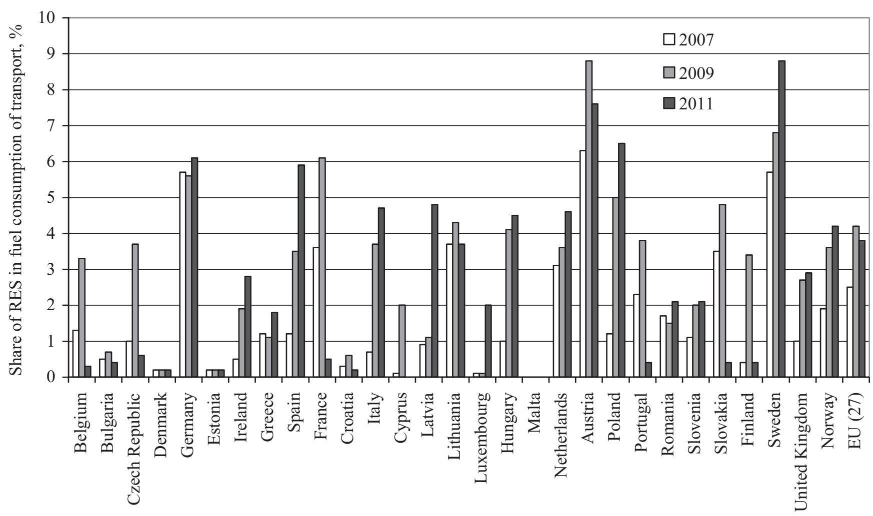


Fig. 7. The share of RES in fuel consumption of transport in 2007, 2009 and 2011 for Lithuania and the EU-27 countries.

expected RES contribution to each sector of the final energy consumption up to 2020 are shown in Figs. 8 and 9 [59].

According the National Renewable Energy Action Plan of Lithuania for the period 2012–2020 are expected that gross final energy consumption for heating and cooling will increase about 9% (from 2454 to 2684 ktoe), for electricity – about 23% (from 970 to 1193 ktoe) and for transport – about 23% (from 1405 to 1734 ktoe), Fig. 8.

For the period 2012–2020 it is presumed that RES contribution in Lithuania will rise by 1.6 times (from 930 to 1474 ktoe), of which RES consumption for heating and cooling will increase by 1.4 times (from 748 to 1051 ktoe), for electricity – by 2.4 times (from 106 to 254 ktoe) and for transport – by 2.2 times (from 76 to 169 ktoe), Fig. 9.

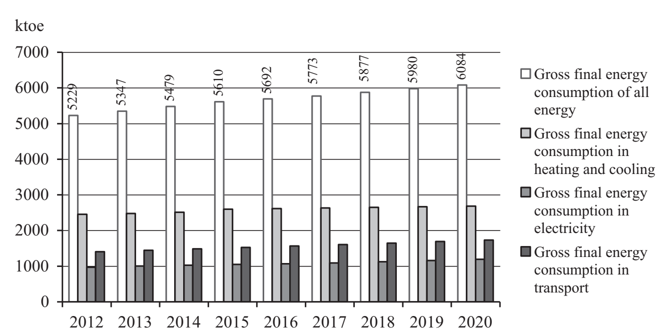


Fig. 8. Expected gross final energy consumption in Lithuania for heating and cooling, electricity and transport sectors up to 2020.

4. Feed-in tariffs for RES in Lithuania

Feed-in tariffs for the RES in Lithuania are on the competence of the National Control Commission (NCC) for Prices and Energy. It is an independent national regulatory authority (in the EU law sense) regulating activities of entities in the field of energy and carrying out the supervision of state energy sector [67]. The NCC was established under the Law on Energy. Since November 2008 the members of the NCC are appointed by the Parliament of the Republic of Lithuania on the nomination of the President of the Republic of Lithuania. **NCC mission** is to ensure the quality and availability of energy services to consumers, creating equal conditions for all market participants. **NCC objective** is to create a credible, independent economic regulatory framework of electricity, natural gas, district heating, drinking water supply and wastewater treatment sectors, which ensures the quality and availability of energy services to consumers. The mission and objectives of NNC are shown in Fig. 10.

The main directions of NCC activities: to protect consumer rights and legitimate interests; to ensure transparent, non-discriminatory, predictable business conditions in every energy sector, by promoting competition, self-regulation and technological changes; to increase efficiency of entities activities through economic regulatory incentives and implementing requirements for enforcement measures; integration into the EU single market and regulatory space; transparent, open, flexible institution activity. NCC for Prices and Energy: prepare and approve the feed-in tariffs methodology; set a maximum feed-in tariffs for the renewable plants with a total installed capacity over 10 kW; set a feed-in tariffs for the renewable plants with a total installed capacity up to 10 kW; prepare and approve the regulations of the quota auctions; publish and organize the quota auctions for the renewable plants with a total installed capacity over 10 kW etc. NCC sets a maximum feed-in tariffs for electricity from RES plant with installed capacity over 10 kW and feed-in tariffs for RES producers with installed capacity up to 10 kW every quarter. RES producers with installed capacity up to 10 kW may get a different feed-in tariff every quarter. The producer gets the tariff which is valid for that day when the electricity is supplied to the grid. These producers gets feed-in tariff only for 50 percent produced electricity to the grid through the calendar year. So it means that producers must use electricity for their own needs. Tariffs for electricity from RES in Lithuania which were set by NCC for the period 2007–2010 are shown on Table 3 and for the period 2011–2013 – in Table 4.

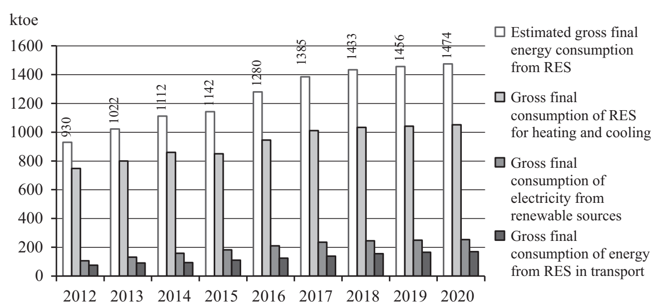


Fig. 9. Expected renewable energy contributions of each sector to final energy consumption in Lithuania up to 2020.

For the period 2007–2010 Lithuanian tariffs for biomass and biogas increased from 0.058 to 0.087 EUR/kWh, for wind energy – from 0.064 to 0.087 EUR/kWh and for hydro power – from 0.058 to 0.075 EUR/kWh. In 2010 were set tariffs for solar energy (integrated and non integrated into the buildings), which mediate in the range 0.437–0.472 EUR/kWh in according to installed capacity. For the period 2011–2013 Lithuanian tariffs for RES were graduated in according to installed capacities (IC). Tariffs for biomass (for new power plant construction) IC < 30 kW increased from 0.087 to 0.145 EUR/kWh, for wind energy – from 0.087 to 0.107 EUR/kWh, for hydro power – from 0.075 to 0.081 EUR/kWh and for biogas (for power plants using landfill gas) – from 0.087 to 0.127 EUR/kWh, Table 4.

Guaranteed tariffs for electricity generated by RES plants with installed capacity over 10 kW are awarded through the auctions, which is organized by NCC. The feed-in tariffs are guaranteed for 12 years after RES producers get a permission to produce electricity to the grid.

The RES plant with installed capacity over 10 kW must participate in the auction if it wants to get a feed-in tariff. The winner of the auction is that producer who has proposed the lowest preferred feed-tariff. If two or more auction's participants have submitted proposals with the same preferred tariff, the winner will be that producer who offered to build the bigger RES plant (bigger installed capacity). The auctions are organized as long as there is a free promotion quota. NCC starts to organize the auctions after gets a request from producer. NCC approves the auction's specification during the period of 30 days.

5. The measures taken to ensure availability of necessary funding to achieve the Lithuanian targets for the RES

The legal Lithuanian base:

– The Description of the Procedure for the Promotion of the Production and Purchase of Electricity the Production of which Involves the Use of RES approved by Resolution No. 1474 of the Government of the Republic of Lithuania of 5 December 2001 (Valstybes Zinios (Official Gazette), 2001, No. 104-3713; 2004, No. 9-228; 2005, No. 73-2651; 2006, No. 100-3862; 2009, No. 49-1958);

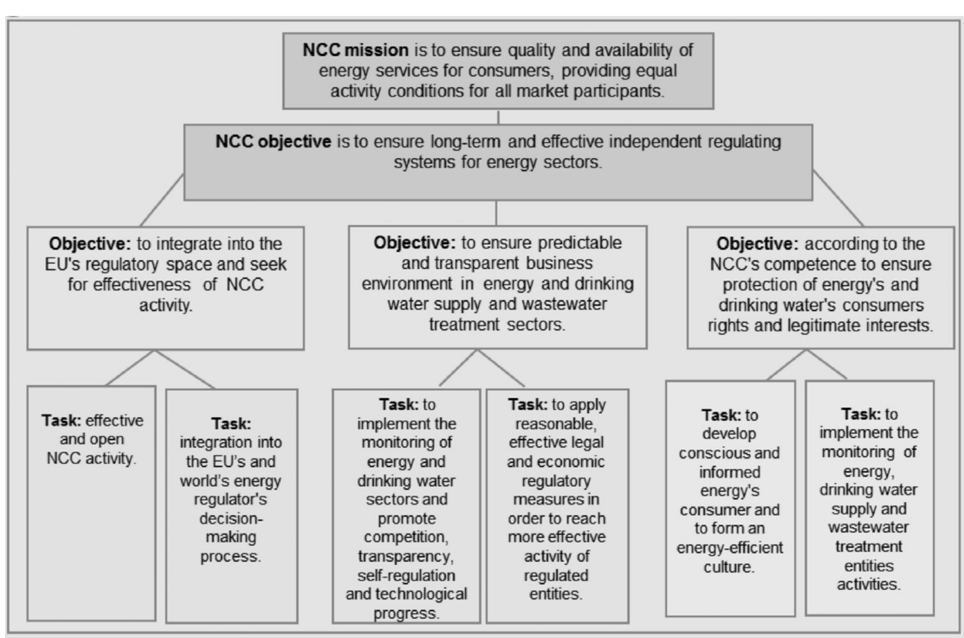


Fig. 10. The mission and objectives of National Control Commission for Prices and Energy.

Table 3
Tariffs for electricity from RES in Lithuania for the period 2007–2010, EUR/kWh.

	2007	2008	2009	2010
Hydro-power				
IC[a] < 30 kW	0.058	0.058	0.075	0.075
30 kW < IC > 350 kW				
350 kW < IC > 1000 kW				
IC > 1000 kW				
Wind energy				
IC < 30 kW	0.064	0.064	0.087	0.087
30 kW < IC > 350 kW				
IC > 350 kW				
Biomass				
IC < 30 kW	0.058	0.064	0.087	0.087
30 kW < IC > 350 kW				
350 kW < IC > 5000 kW				
IC > 5000 kW				
Biogas (for power plants using landfill gas)				
IC < 30 kW	0.058	0.064	0.087	0.087
30 kW < IC > 350 kW				
350 kW < IC > 500 kW				
IC > 500 kW				
350 kW < IC > 1000 kW				
IC > 1000 kW				
Biogas (for power plants using biogas derived from anaerobic digestion or other biodegradable organic waste or substrates)				
IC < 30 kW	0.058	0.064	0.087	0.087
30 kW < IC > 350 kW				
350 kW < IC > 500 kW				
500 kW < IC > 1000 kW				
350 kW < IC > 1000 kW				
1000 kW < IC > 2000 kW				
IC > 1000 kW				
IC > 2000 kW				
Solar energy (non integrated into the buildings)				
IC < 30 kW	–	–	–	0.472
30 kW < IC > 100 kW				
100 kW < IC > 350 kW	–	–	–	0.452
IC > 350 kW				
100 kW < IC > 1000 kW				
IC > 1000 kW				0.437
Solar energy (integrated into the buildings)				
IC < 30 kW	–	–	–	0.472
30 kW < IC > 100 kW				
100 kW < IC > 350 kW	–	–	–	0.452
IC > 350 kW				
100 kW < IC > 1000 kW				
IC > 1000 kW				0.437

[a] IC – installed capacity.

- Resolution No. 7 of the NCC for Prices and Energy of 11 February 2002 regarding prices of services meeting public interests in the electricity sector (Valstybes Zinios (Official Gazette), 2002, No. 16-648; 2007, No. 73-1041; 2008, No. 16-217; No. 77-1002; 2009, No. 108-4576);
- The Description of the Procedure for the Provision of Services Meeting Public Interests approved by Order No. 1-215 of the Minister of Energy of the Republic of Lithuania of 24 November 2009 (Valstybes Zinios (Official Gazette), 2009, No. 140-6159);
- Order No. 1-214 of the Minister of Energy of the Republic of Lithuania regarding the establishment of the List of Services Meeting Public Interests in the Electricity Sector (Valstybes Zinios (Official Gazette), 2009, No. 140-6158).

5.1. The measures for power generation

Public and independent suppliers, market, transmission and distribution networks operators as well as free consumers importing electricity are obliged to provide established services meeting public interests. The price of services meeting public interests includes the amount of funds necessary for payment for electricity produced from renewable energy sources. All market participants whose electricity installations are connected to transmission and/or distribution networks and who in their internal networks use and/or operate electricity producing installations for own use by plant, when the total installed capacity of their electricity producing installations is equal to or greater than 35MW, must declare the amounts of produced energy to transmission system or distribution networks operators and to pay for services meeting public interests.

5.1.1. Feed-in tariff system

Since 2002, Lithuania has a feed-in tariff with purchase obligation. The Law on Electricity adopted on 2004 dictates that the NCC for Prices and Energy must ensure that network connection conditions and tariffs for new electricity producers are objective, transparent and non-discriminatory, while taking into

Table 4
Tariffs for electricity from RES in Lithuania for the period 2011–2013, EUR/kWh.

	2011	2012	2013 I quart.	2013 II quart.	2013 III quart.	2013 IV quart.
Hydro-power						
IC* < 10 kW				0.078	0.078	0.078
IC < 30 kW	0.075	0.081	0.081			
10 kW < IC>350 kW				0.070	0.070	0.070
30 kW < IC>350 kW	0.075	0.078	0.078			
350 kW < IC>1000 kW						
IC>1000 kW		0.064	0.064	0.064	0.064	0.064
Wind energy						
IC < 10 kW				0.096	0.096	0.096
IC < 30 kW	0.087	0.107	0.107	0.093	0.093	0.093
30 kW < IC>350 kW		0.104	0.104			
10 kW < IC>350 kW						
IC>350 kW	0.087	0.081	0.075	0.075	0.075	0.075
Biomass (for new power plant construction)						
IC < 10 kW				0.142	0.116	0.116
IC < 30 kW	0.087	0.145	0.145	0.130	0.098	0.098
10 kW < IC>350 kW						
30 kW < IC>350 kW	0.087	0.130	0.130			
350 kW < IC>5000 kW						
IC>5000 kW		0.107	0.107	0.110	0.090	0.090
Biomass (reconstruction of operating plant)						
IC < 10 kW					0.107	0.107
10 kW < IC>5000 kW					0.093	0.093
IC>5000 kW					0.084	0.084
Biogas (for power plants using landfill gas)						
IC < 10 kW				0.125	0.125	0.125
IC < 30 kW	0.087	0.185	0.127	0.119	0.119	0.119
30 kW < IC>350 kW		0.168	0.122			
10 kW < IC>350 kW						
350 kW < IC>500 kW	0.087	0.168	0.122			
IC>500 kW			0.098	0.096	0.096	0.096
350 kW < IC>1000 kW				Abolished differentiation		
IC>1000 kW		0.139		0.096	0.096	0.096
Biogas (for power plants using biogas derived from anaerobic digestion or other biodegradable organic waste or substrates)						
IC < 10 kW				0.159	0.159	0.159
IC < 30 kW	0.087	0.185	0.171	0.148	0.148	0.148
10 kW < IC>350 kW						
30 kW < IC>350 kW	0.087	0.168	0.159			
350 kW < IC>500 kW						
500 kW < IC>1000 kW			0.148	0.139	0.139	0.139
350 kW < IC>1000 kW				Abolished differentiation		
1000 kW < IC>2000 kW		0.139	0.139	0.133	0.133	0.133
IC>1000 kW				Abolished differentiation		
IC>2000 kW			0.136	0.127	0.127	0.127
Solar energy (non integrated into the buildings)						
IC < 10 kW				0.217	0.177	0.162
IC < 30 kW	0.472	0.417	0.362	0.20	0.162	0.151
30 kW < IC>100 kW		0.414	0.336			
10 kW < IC>100 kW						
100 kW < IC>350 kW	0,452	0.301	0.261	0.185	0.151	0.139
IC>350 kW						
100 kW < IC>1000 kW						
IC>1000 kW	0.437					
Solar energy (integrated into the buildings)						
IC < 10 kW				0.281	0.229	0.211
IC < 30 kW	0.472	0.521	0.463	0.252	0.206	0.191
30 kW < IC>100 kW		0.481	0.429			
10 kW < IC>100 kW						
100 kW < IC>350 kW	0.452	0.371	0.330	0.235	0.191	0.177
IC > 350 kW						
100 kW < IC > 1000 kW						
IC > 1000 kW	0.437					

account all costs and benefits derived from RES [68]. The feed-in tariff system is managed by the NCC for Prices and Energy [67]. In 2008 was approved an amendment on the feed-in tariff of electricity produced from wind, biomass and hydro energy. In the 2009 was approved the feed-in tariff of electricity produced at PV installations.

5.1.2. *Structural support of the EU for the period 2007–2013*

Biofuel, wind (when the installed capacity of the power plant is up to 250 kW) and solar power plants can receive structural support of the EU for investments. Responsible for the management is the Ministry of Economy of the Republic of Lithuania.

The institution implementing the measure is the Public Institution "Lithuanian Business Support Agency". Funds are appropriated from the structural funds of the EU in the course of the implementation of the Cohesion Promotion Action programme. By Resolution No. 60 of the Government of the Republic of Lithuania of 2007 (Valstybės Žinios (Official Gazette), 2007, No. 10-396; 2008, No. 4-133; 2009, No. 102-4252), the Monitoring Committee for supervising the implementation of the action programmes implementing the Lithuanian Strategy for the Use of structural support of the EU for 2007–2013 was established. Assessments, studies, and research (hereinafter referred to as assessments) of the use of structural support of the EU in Lithuania (which were performed by independent experts at the request of various institutions) are published on the internet site "EU Structural Support for 2007–2013" [69]. There are periodical calls for submission of applications. Under this scheme, subsidies amounting up to 50% of the eligible costs of a project are granted. The value of the project may not exceed LTL 172.64 million. Legal persons complying with the established criteria can benefit from this scheme. The scheme is specified for technologies using biofuel for energy production. The following is financed in accordance with the measure of the use of RES for energy production:

- Modernization of cogeneration power plants supplying heating to heating supply systems – replacement of the usable fuel with biomass;
- Construction of new effective cogeneration power plants using RES and their connection to heating supply systems.

5.1.3. Lithuanian Rural Development Programme for 2007–2013

Such Program prepared pursuant to the provisions of Council Regulation (EC) No. 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) as well as of Commission Regulation No. 1974/2006 laying down detailed rules for the application of this Council Regulation. Also, this document in all aspects meets the provisions of Council Regulation No. 2006/144/EC on Community strategic guidelines for rural development, which were transposed to the National Strategy of Lithuania for the corresponding period. Responsible institution is the Ministry of Agriculture of the Republic of Lithuania. Institution implementing the measure is the National Paying Agency under the Ministry of Agriculture.

The intensity of support varies from 40 to 65% of eligible project expenses. The maximum project support amount depends on the measure of the program and may range from EUR 40.000 to EUR 2.8 million.

5.1.4. Lithuanian Environmental Investment Fund

The objectives of the activities of the Lithuanian Environmental Investment Fund (LEIF) is to contribute to the reduction of environmental pollution and prevention of pollution by financing projects reducing negative impact on the environment and ensuring continuity of the environmental effect. The fund (LEIF) finances projects related to electricity production with the use of RES, such as wind (when the installed capacity of the power plant is up to 250 kW), solar, water and biomass energy sources.

30% of environmental pollution tax is paid to the state budget. These funds are used in accordance with the intended purpose for the financing of environmental investment projects envisaged in the program of the LEIF. Each year, the Supervisory Council of the LEIF approves the priorities (financing directions) of the field of environmental investments, with regard to which financing of investment projects is carried out. Support does not differ according to technology. According to this system, subsidies are granted. The amount of subsidy to be granted to one beneficiary may not exceed LTL 690,000 over a period of three years and 70% of the whole amount of an environmental investment project. By submitting an application, an applicant undertakes to achieve certain environmental indicators, i.e. to produce a certain amount of energy from RES. The LEIF verifies the execution of the planned obligations. It is regulated by the following: The Law on Environmental Pollution Tax (Valstybės Žinios (Official Gazette), 1999, No. 47-1469; 2002, No. 13-474; 2005, No. 47-1560) and The Description of the Procedure for the Financing and Supervision of Projects of the Public Institution Lithuanian Environmental Investment Fund (Valstybės Žinios (Official Gazette), 2003, No. 85-3890, 2004, No. 143-5237, 2007, No. 114-4650).

5.1.5. Benefit on excise duty

Excise duty shall not be levied on electricity produced with the use of renewable energy sources. Responsible institution is the Ministry of Finance of the Republic of Lithuania. Institution implementing the measure is the State Tax Inspectorate under the Ministry of Finance of the Republic of Lithuania. The scheme came into effect from 2010. The Law of the Republic of Lithuania on Excise Duty (Valstybės Žinios (Official Gazette), 2001, No. 98-3482; 2004, No. 26-802).

5.1.6. Benefit from connecting to electricity network

Wind power plants, biomass power plants, solar power plants as well as hydropower plants with capacities not exceeding 10 MW are connected to operating networks of energy companies in accordance with the procedure established by legal acts while applying a 40% discount on the connection fee, which is credited as purchase of services meeting public interests and is compensated next year to operators who connected the power plants.

5.2. Measures for heat generation

5.2.1. Structural support of the EU for the investments for 2007–2013

The scheme is specified for the technologies using biofuel for energy production. The following is financed in accordance with the measure of the use of renewable energy sources for energy production:

- Modernization of cogeneration power plants supplying heating to heating supply systems – replacement of the usable fuel with biomass;
- Construction of new effective cogeneration power plants using renewable energy sources and their connection to heating supply systems.

5.2.2. Benefit on environmental pollution tax

Benefit on environmental pollution tax can be applied when natural and legal persons who have submitted documents confirming consumption of biofuel shall be released from environmental pollution tax in respect of pollutants emitted into the atmosphere from stationary pollution sources as a result of the use of biofuel. Environmental pollution tax from stationary pollution sources shall be paid by operators operating such fuel-burning installations in the energy industry whose nominal thermal capacity is greater than 50 MW as well as by operators using at least one solid fuel boiler whose thermal capacity amounts to or is greater than 0.5 MW, or use a stationary incineration source whose thermal capacity amounts to or is greater than 1.0 MW.

The Law on Environmental Pollution Tax (Valstybės Žinios (Official Gazette), 1999, No. 47-1469; 2002, No. 13-474; 2005, No. 47-1560).

5.3. Support schemes to promote the RES in transport

The Government of the Republic of Lithuania or institutions authorized by the Government shall prepare measures ensuring that the share of biofuels would account for not less than 2% and 5.75% of the total energy quantity of petrol and diesel fuel intended for transport available in the market of the country by December 2005 and December 2010, correspondingly. To increase the share of biofuels in the country's market of fuels intended for transport to 10% by 2020. There is a differentiation of the support according to fuel types.

The Law of the Republic of Lithuania on Biofuel, Biofuels for Transport, and Bio-Oils (Valstybės Žinios (Official Gazette), 2000, No. 64-1940; 2004, No. 28-870).

No technology-specific targets are established. The Government of the Republic of Lithuania or institutions authorized by the Government is responsible for target achievement.

5.3.1. Financing the development of biofuel' production for transport

A portion of the price of rape oil intended for the production of rapeseed methyl (ethyl) ester (RME) and a portion of the price of rape seed and cereal grain purchased for the production of dehydrated ethanol shall be compensated. Responsible institution is the Ministry of Agriculture of the Republic of Lithuania. The institution implementing the measure is the National Paying Agency under the Ministry of Agriculture.

Funds are provided in the state budget on an annual basis. The scheme is revised and updated on an annual basis. Yearly economic and financial indicators of biofuel producers are analyzed in order to avoid overruns of the support. Support differs according to raw materials used. Order No. 3D-658 of the Minister of Agriculture of the Republic of Lithuania of 9 September 2009 regarding the amendment of Order No. 3D-417 of the Minister of Agriculture regarding the approval of the Rules for Financing the Development of the Production of Biofuels for Transport (Valstybės Žinios (Official Gazette), 2009, No. 110-4686). Amendment of this legal act is planned for August 2010 with a view to establishing the compensable quantity of raw materials for 2010. The start date of the implementation of the system: 2004; the end date of the implementation of the scheme: 31 December 2012. The greatest quantity of compensable rapeseed for all beneficiaries in the country in 2009 was 66.816 tons; that of cereal grains was 46.569 tons.

A portion of the price of rape oil intended for the production of rapeseed methyl (ethyl) ester (RME) and a portion of the price of rape seed and cereal grain purchased for the production of dehydrated ethanol can be compensated.

According to the Law of the Republic of Lithuania on Environmental Pollution Tax, natural and legal persons using biofuels meeting established standards shall be released from environmental pollution tax in respect of pollutants emitted from mobile pollution sources.

5.3.2. Envisaged new measure – special program for the development of RES

The Law of the Republic of Lithuania on Energy from Renewable Sources envisages drawing up the following in order to promote the use of renewable energy sources including that for electricity production: The Special National Programme for the Development of Renewable Energy Sources; Special municipal programmes for the development of renewable sources.

The sources are envisaged:

- 30% of excise duty proceeds received for the sale of liquid fuel (heavy fuel oil), orimulsion, natural gas, coal, coke and lignite, gas oil intended for heating (domestic heating fuel) used for the production of heating and electricity as well as for the sale of electricity;
- 30% of corporate income tax received from biofuel producers and suppliers as well as from producers of renewable energy sources;
- 40% of funds from the Special Climate Change Programme;
- Voluntary funds of natural and legal persons and foreign countries intended for the development of the use of renewable energy sources;
- Other lawfully received funds.

5.3.3. The measures envisaged in the Plan of Measures for the Implementation of the National Strategy for the Development of RES for 2010–2015

- To prepare and approve municipal action plans for the use of RES for 2011–2020, where the goals for the use of RES and measures for achieving these goals would be established;
- To prepare draft legal acts necessary for the drawing up of the Special National Programme for the Promotion of the Development of RES (intended for the financing of projects on RES), to envisage the objectives and sources of financing of this Program and to prepare a procedure for the use of the funds of this Program.

6. Conclusions

After the closure of the Ignalina nuclear power plant at the end of 2009, Lithuania's energy dependence on the imports of fossil fuel increased considerably – from 50.3% in 2009 to 81.8% in 2011, and substantially exceeded the EU average 53.8%. As the prices of imported organic fuel in Lithuania progressively grow, as a result, the usage of indigenous and renewable energy sources gradually increased. In 2011 the part of indigenous and renewable energy sources in gross inland energy consumption in Lithuania comprised 18.3%. The biggest part of renewable was biomass – 86.5%, liquid biofuel – 4.4%, hydropower – 3.9%, wind energy – 3.9%, biogas – 1.0% and geothermal energy – 0.3%.

The strategic goal of the national development of RES is to satisfy the demand for energy with local resources to the maximum extent possible, to abandon imported polluting fossil fuel, thus improving the reliability of energy supply and energy independence and to contribute to international efforts to reduce emissions of greenhouse gas by increasing the share of RES in the country's energy balance, in the electricity and heating, and transport sectors. Increasing the use of RES is set in Lithuanian National reform program. Development of RES is an important alternative to traditional energy, which is helpful not only in addressing climate change issues, but also in increasing Lithuania's energy independence. Lithuania has set its national target for increasing the share of RES in its gross final energy consumption to 23% by 2020. In 2011, energy produced from RES was about 20.3% (in 2010–19.8%) in the Lithuania's gross final energy consumption. Since energy produced from RES is generally more expensive than that extracted from fossil fuels, development in the use of RES is supported by the state. At present, the following support measures are being used: access to a grid discount, priority for RES in cases of limited transmission capacity, excise tax concessions for biofuels, feed-in tariffs for electricity and heat purchases, and concessions for balancing electricity.

The overviews of available RES support instruments for electricity, heat and cooling, and transport in Lithuania and EU countries was carried out.

Feed-in tariff systems have been historically and currently still are the main instruments of support in the EU. Lithuania applies a feed-in tariff and investment grants support mechanisms. In Lithuania the feed-in tariff is the main instruments of support applied to purchasing electricity produced at wind, biomass and solar power plants as well as hydropower plants.

Financial support instruments for RES heat and cooling can be grouped into four categories: investment grants, tax exemptions, financial incentives, and premiums/bone. The deployment of (combinations) of these instruments varies largely from country to country and from technology to technology. The main support comes in the form of investment grants and tax exemptions. These two mechanisms are used in Lithuania.

The support for biofuel consumption in the EU countries and in Lithuania is often a combination of a quota obligation with tax exemptions. The levels of support for biofuel obligations are very difficult to assess since the prices implied by these obligations are typically not public.

Lithuania also applies the structural support of the EU for investments for the period 2007–2013, Lithuanian Rural Development Programme for 2007–2013 and Lithuanian Environmental Investment Fund.

References

[1] Official journal of the EU, 2009. Directive 2009/28/EC of the European Parliament of the Council of 23 April 2009 on promotion of the energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. L 140; 5.6.2009. p. 16.

[2] Share of renewable energy in gross final energy consumption. Available from: 〈http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdcc110〉.

[3] Katinas V, Markevicius A, Perednis E, Savickas J. Sustainable energy development – Lithuania's way to energy supply security and energetics independence. Renew Sustain Energy Rev 2014;30(2014):420–8.

[4] Lind A, Rosenberg E, et al. Analysis of the renewable energy directive by a techno-economic optimization model. Energy Policy 2013;60(2013):364–77.

[5] Klessmann C, Held A, Rathmann M, Ragwitz M. Status and perspectives of renewable energy policy and deployment in the European Union–what is need to reach the 2020 targets. Energy Policy 2011;39:7637–57.

[6] Kontogiani A, Tourkolias C, Skourtos M. Renewables portfolio, individual preferences and social values towards RES technologies. Energy Policy 2013;55(2013):467–76.

[7] De Lucia C, Bartlett M. Implementing a biofuel economy in the EU: lessons from the SUSTOIL project and future perspectives for next generation biofuels. Renew Sustain Energy Rev 2014;29(2014):22–30.

[8] Cochran J, Mai T, Bazilian M. Meta-analysis of high penetration renewable energy scenarios. Renew Sustain Energy Rev 2014;29(2014):246–53.

[9] Scarlat N, Dallemand JF, Motola V, Monforti-Ferrario F. Bioenergy production and use in Italy: recent developments, perspectives and potential. Renew Energy 2013;57(2013):448–61.

[10] Abu-Bakar SH, Muhammad-Sukki F, Ramirez-Iniguez R, Mallick TK, McLennan C, Munir AB, et al. Is renewable heat incentive the future? Renew Sustain Energy Rev 2013;26:365–78.

[11] Farooq MK, Kumar S, Shrestha RM. Energy, environmental and economic effects of Renewable Portfolio Standards (RPS) in a developing country. Energy Policy 2013;62(2013):989–1001.

[12] Blindheim B. Implementation of wind power in the Norwegian market; the reason why some of the best wind resources in Europe were not utilised by 2010. Energy Policy 2013;58(2013):337–46.

[13] Cansino JM, Pablo-Romero MP, Roman R, Yniguez R. Promotion of biofuel consumption in the transport sector: an EU-27 perspective. Renew Sustain Energy Rev 2012;16(2012):6013–21.

[14] Swider DJ, Beurskens L, Davidson S, Twidell J, Pyrko J, Pruggler W, et al. Conditions and costs for renewable electricity grid connection: Examples in Europe. Renew Energy 2008;33(2008):1832–42.

[15] Ostergaard PA. Reviewing optimization criteria for energy systems analyses of renewable energy integration. Energy 2009;34(2009):1236–45.

[16] Lund H, Mathiesen BV. Energy system analysis of 100% renewable energy systems – the case of Denmark in years 2030 and 2050. Energy 2009;34(2009):524–31.

[17] Ban M, Perkovic L, Duic N, Penedo R. Estimating the spatial distribution of high altitude wind energy potential in Southeast Europe. Energy 2013;57(2013):24–9.

[18] Aslani A, Naaranoja M, Wong KV. Strategic analysis of diffusion of renewable energy in the Nordic countries. Renew Sustain Energy Rev 2013;22(2013):497–505.

[19] Mondol JD, Koumpetsos N. Overview of challenges, prospects, environmental impacts and policies for renewable energy and sustainable development in Greece. Renew Sustain Energy Rev 2013;23(2013):431–42.

[20] Dowling P. The impact of climate change on the European energy system. Energy Policy 2013;60:406–17.

[21] Pregger T, Nitsch J, Naegler T. Long term scenarios and strategies for the deployment of renewable energies in Germany. Energy Policy 2013;59:350–60.

[22] Zhao Y, Tang KK, Wang L. Do renewable electricity policies promote renewable electricity generation? Evidence from panel data Energy Policy 2013;62(2013):887–97.

[23] Wachsmuth J, Blohm A, et al. How will renewable power generation be affected by climate change? The case of a Metropolitan Region in Northwest Germany Energy 2013;58(2013):192–201.

[24] Tian Y, Zhao CY. A review of solar collectors and thermal energy storage in solar thermal applications. Appl Energy 2013;104(2013):538–53.

[25] Haas R, Lettner G, Auer H, Duic N. The looming revolution: how photovoltaics will change electricity markets in Europe fundamentally. Energy 2013;57(2013):38–43.

[26] Golušin M, Ivanovič OM, Redžepagič S. Transition from traditional to sustainable energy development in the region of Western Balkans – current level and requirements. Appl Energy 2013;101:182–91.

[27] Ek K, Persson L, Johansson M, Waldo A. Location of Swedish wind power – random or not? A quantitative analysis of differences in installed wind power capacity across Swedish municipalities Energy Policy 2013;58(2013):135–41.

[28] Gass V, Schmidt J, Strauss F, Schmid E. Assessing the economic wind power potential in Austria. Energy Policy 2013;53(2013):323–30.

[29] Sivek M, Kavina P, Malečkova V, Jirasek J. Czech Republic and indicative targets of the European Union for electricity generation from renewable sources. Energy Policy 2012;44:469–75.

[30] Colesca SE, Ciocoiu CA. An overview of the Romanian renewable energy sector. Renew Sustain Energy Rev 2013;24(2013):149–58.

[31] Burgos-Payan M, Roldan-Fernandez JM, Trigo-Garcia AL, Bermudez-Rios JM, Riquelme-Santos JM. Costs and benefits of renewable production of electricity in Spain. Energy Policy 2013;56:259–70.

[32] Pablo-Romero MP, Sanchez-Braza A, Perez M. Incentives to promote solar thermal energy in Spain. Renew Sustain Energy Rev 2013;22(2013):198–208.

[33] Kaldellis JK, Kapsali M, Katsanou Ev. Renewable energy applications in Greece – what is a public attitude? Energy Policy 2012;42:37–48.

[34] Punys P, Baublys R, Kasiulis E, Vaisvila A, Pelikan B, Steller J. Assessment of renewable electricity generation by pumped power plants in EU Member States. Renew Sustain Energy Rev 2013;26(2013):190–200.

[35] Trutnevyte E. EXPANSE methodology for evaluating the economic potential of renewable energy from an energy mix perspective. Appl Energy 2013;111(2013):593–601.

[36] Chang MK, Eichman JD, Mueller F, Samuelsen S. Buffering intermittent renewable power with hydroelectric generation: a case study in California. Appl Energy 2013;112(2013):1–11.

[37] Connor P, Burger V, Beurskens L, Ericsson K, Egger C. Devising renewable heat policy: overview of support options. Energy Policy 2013;59(2013):3–16.

[38] Bertoldi P, Rezessy S, Oikonomou V. Rewarding energy savings rather than energy efficiency: exploring the concept of feed-in tariff for energy savings. Energy Policy 2013;56(2013):526–35.

[39] White LV, Lloyd B, Wakes SJ. Are feed-in tariffs suitable for promoting solar PV in New Zealand cities? Energy Policy 2013;60(2013):167–78.

[40] Fagiani R, Barquin J, Hakvoort R. Risk-based assessment of the cost-efficiency and the effectivity of renewable energy support schemes: certificate markets versus feed-in tariffs. Energy Policy 2013;55(2013):648–61.

[41] Mudasser M, Yiridoe EK, Corscadden K. Economic feasibility of large community feed-in tariff-eligible wind energy production in Nova Scotia. Energy Policy 2013;62(2013):966–77.

[42] MacPherson R, Lange I. Determinants of green electricity tariff uptake in the UK. Energy Policy 2013;62(2013):920–33.

[43] Kost C, Flath CM, Most D. Concentrating solar power plant investment and operation decisions under different price and support mechanisms. Energy Policy 2013;61(2013):238–48.

[44] Connor P. Policies to support the growth of renewable energy sources of heat. Energy Policy 2013;59:1–2.

[45] Jager D, Klessmann C, Stricker E, Winkel T, Visser E, Koper M., et al. Financing renewable energy in the European energy market. By order of the European Commission, DG energy, TREN/D1/518-2008. Ecofys, Utrecht; 2011.

[46] Haas R, Panzer C, Resch G, Ragwitz M, Reece G, Held A. A historical review of promotion strategies for electricity from renewable energy sources in EU countries. Renew Sustain Energy Rev 2011;15(2011):1003–34.

[47] European Commission. National renewable energy action plans, submitted by EU Member States in line with EC Directive 2009/28/EC. May 2011. Available from: 〈http://ec.europa.eu/energy/renewables/transparency_platform/action_plan_en.htm〉; 2011a.

[48] Katinas V, Skema R. Renewable energy policy in Lithuania. Energy Policy 2001;29(10):811–6.

[49] Katinas V, Markevicius A. Promotional policy and perspectives of usage renewable energy in Lithuania. Energy Policy 2006;34(7):771–80.

[50] Katinas V, Markevicius A, Erlickyte R, Marciukaitis M. Governmental policy and prospect in electricity production from renewables in Lithuania. Energy Policy 2008;36:3686–91.

[51] Perednis E, Katinas V, Markevičius A. Assessment of wood fuel use for energy generation in Lithuania. Renew Sustain Energy Rev 2012;16(2012):5391–8.

[52] Streimikiene D, Volochovic A, Simanaviciene Z. Comparative assessment of policies targeting energy use efficiency in Lithuania. Renew Sustain Energy Rev 2012;16(2012):3613–20.
[53] Streimikiene D, Baležentis T, Kriščiukaitienė I. Promoting interactions between local climate change mitigation, sustainable energy development and rural development policies in Lithuania. Energy Policy 2012;50:699–710.
[54] Streimikiene D. The impact of international GHG trading regimes on penetration of new energy technologies and feasibility to implement EU Energy and Climate Package targets. Renew Sustain Energy Rev 2012;16(2012):2172–7.
[55] Gaigalis V, Skema R. Analysis of fuel and energy consumption in Lithuania and its industry during the period 2000–2006. Energetika. (ISSN 0235-7208) T. 53, No. 4, p. 90–98; 2007.
[56] Gaigalis V, Skema R. Analysis of Lithuanian economy development and fuel and energy consumption in 2004–2008. Energetika. (ISSN 0235-7208) T. 56, No. 3–4, p. 186–192; 2005.
[57] National Energy Independence Strategy of the Republic of Lithuania. Resolution No. XI-2133 of the Seimas of the Republic of Lithuania of 26 June 2012. Available from: 〈http://www.enmin.lt/lt/activity/veiklos_kryptys/strateginis_planavimas_ir_ES/Energy_independence_strategy0919.pdf〉.
[58] Valstybes Zinios (Official Gazette) No. 73-3725. National strategy for the development of Renewable Energy Sources. Resolution of 21 June 2010 No. 789, Vilnius; 2010.
[59] National Renewable Energy Action Plan LT. Available from: 〈http://www.ebb-eu.org/legis/ActionPlanDirective2009_28/national_renewable_energy_action_plan_lithuania_lt.pdf〉; 2010.
[60] Energy balance 2009. Statistics Lithuania. Vilnius; 2010.
[61] Energy balance 2010. Statistics Lithuania. Vilnius; 2011.
[62] Energy balance 2011. Statistics Lithuania. Vilnius; 2012.
[63] Statistical yearbook of Lithuania. Sustainable development indicators. Statistics Lithuania, Vilnius; 2010.
[64] Statistics Lithuania. Sustainable development indicators. Available from: 〈http://www.stat.gov.lt/uploads/docs/Darnus_vystymasis_2012.pdf〉; 2012.
[65] Electricity generated from renewable sources. Available from: 〈http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdcc330〉.
[66] Share of renewable energy in fuel consumption of transport. Available from: 〈http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdcc340〉.
[67] National control commission for prices and energy. Available from: 〈http://www.regula.lt/en/about-us/〉.
[68] Law on Electricity of Lithuania (Revised version). Lithuanian Seimas doc. No. IX-2307, 1 July 2004, Vilnius; 2004.
[69] EU structural support for 2007–2013. Available from: www.esparama.lt.